Human urine from city to field - towards sustainable co-operation?

Susanna Degaardt

Kretsloppskontoret (Recycling Office)
Box 11192, 404 24 Göteborg, Sweden
e-mail: a7susdeg@ulmo.stud.slu.se

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Abstract

Possibilities and problems connected with the establishment of a well-functioning recycling system for source separated human urine from a Swedish city to productive land were investigated. Via literature and interviews with people with experience of similar recycling, potential urine users and other stakeholders, the current position was determined. The results show that a potential market exists for source separated human urine as a fertiliser around cities, especially in agriculture. However certain critical issues must be resolved for the desired degree of consumer confidence and knowledge to be achieved regarding human urine and its recycling system within the entire recycling chain. This is possible with good information and quality-assurance measures. There is urgent need for a risk assessment of pharmaceutical residues in the product, not least to enhance end-user and public confidence. Quality assurance systems have been developed for segments of the chain but an overall approach is lacking. One party, e.g. the urban authority or its contractors, must be appointed to a coordinating role. Society should have the final responsibility for the development and function of the recycling system and should be the driving and supporting force when necessary in the development of these new systems.

Source separation of human urine – why and how?

The conventional sewage treatment systems of Swedish cities today do not allow a high level of nutrient recycling back to agriculture. Only a small percentage of the total amount of nutrients is captured in the sludge of the sewage treatment plant, still polluted by compounds not wanted in agricultural fields. Many of the nutrients are instead discharged to recipient waters, causing eutrophication and nitrate poisoning of the groundwater. The Swedish Environmental Protection Agency has recently proposed as a national goal that in 2015 at least 60 % of the phosphorus in sewage must be recycled to productive land, of which at least 50 % should be agricultural land (Naturvårdsverket, 2002).

In recent years, research on source separation of human urine has been carried out on a broad front. The results show that this system opens up for a high level of nutrient recirculation in an environmentally advantageous way, where the hygiene risks can be minimized to an insignificant level (Jönsson et.al., 2000). Although urine represents only 1 % of the volume flow in household wastewater, it contributes 80% of the nitrogen, >50 % of the phosphorus and 80-90 % of the potassium (Vinnerås, 2002). By separating the urine at source, a large proportion of the nutrients can be captured in a small and very clean fraction, which functions well as a fertiliser. A urine separating toilet has a special bowl for urine at the front and another for faeces and paper at the back. The urine and a small amount of flushwater flow separately into a collecting tank in the housing area, from where they are later emptied and transported by a

tanker to a storage tank. It is common that the urine is stored in an unused slurry tank at the farm before application. During storage, the urine is sanitised and after this, it is used as a fertiliser for cereals or other crops.

Increased knowledge of the system has prompted a growing political interest in Sweden for source separation of urine, as one of many ways to achieve a greater recycling of plant nutrients. While in the beginning mainly installed in eco-villages, source separation systems are becoming more frequent in villas, blocks of flats, schools and other institutions. About 2-3000 urine separating porcelain toilets have been sold in Sweden, and in addition to that a large number of plastic ones for summer cottages (Johansson et.al., 1998). According to Swedish law, local municipalities must provide for appropriate collection and treatment, e.g. recirculation, of source separated urine and other sewage fractions kept in a closed tank. There is a need to investigate forms for a well-functioning retrieval system all the way from city buildings to the field. To achieve the political vision of recirculation of nutrients, local planning authorities have to pay attention to the kinds of products and recycling management required by the end-consumers for fertilisers, for example farmers. There are also many other stakeholders along the nutrient recycling path and it is important to investigate how they view co-operation.

Source separation of human urine in the city of Gothenburg and the aim of the study

In Gothenburg, the second largest city in Sweden, there are currently four larger buildings with urine diverting systems installed, together producing some 300 cubic metres of urine-flushwater mixture per year. The city of Gothenburg wishes to create a co-operation with fertiliser consumers for recirculation of this and for an expected increased fraction in future. To achieve this, a feasibility study was initiated, performed as an MSc thesis at the Swedish University of Agricultural Sciences (SLU). The overall questions at issue were:

What are the possibilities and problems in finding an outlet in agriculture or other productive land; and

How can we solve the problems?

Problems and possibilities – views of different stakeholders

Literature studies and conversation with a great number of actors and scientists were performed to explore issues like urine as a plant nutrient; economic and technical aspects of the retrieval system; legal issues of importance; health- and environmental risks; and actor acceptance. Below follows a brief compilation of the information gained from some of the most important stakeholders.

Present and potential urine users in agriculture

Some of the farmers interviewed were interested in using human urine. This interest mainly arose from the need for fertiliser on the farm, the crops grown, the equipment available and the environmental awareness of the farmer. If suitable equipment was not available it could be hired from a contractor but large amounts of urine were required for this to be economically viable. There appeared to be a great need for readily available N fertiliser in organic farming, so if the use of human urine were approved within EU subsidised organic farming, the demand would increase. The international associations for organic farming (IFOAM) can permit human urine that on crops for human consumption, if the urine is sufficiently sanitised. Most farmers are demanding that the nutrient content be assured by analyses etc. Many are sceptical to that the fertilising effect will be as good as stated and potential participants wanted to test the product before agreeing to co-operation. One urine-using farmer questioned was considering stopping because of the poor nutrient concentration in the product when it reaches his farm. There was a fear of being sanctioned by consumers if confidence in urine were to be lost in the future. This

has already happened to farmers fertilising with sewage sludge in 1999, when the mass media raised concerns about the presence of brominated flame-retardants in the sludge. End-users wanted a guarantee that this would not happen and were very interested in the position taken by branch organisations and consumers.

Potential uses in municipal parks and sports fields

It was shown that there is a certain need for fertilisers, which could theoretically be replaced by human urine on e.g. lawns and flowerbeds. Application of human urine by an injection technique in combination with soil spiking has been shown to work well on golf areas (compared to conventional spraying). This method should in principle also work on a park or football pitch but it was not known whether the injection equipment required was available. Acceptance issues are very important for all these areas. What would be the reaction of visitors and of grounds staff? Would there be an undesirable smell? A desire was expressed for much more information and for precise details of the urine composition. Staff and sports players would be exposed to the fertilised soil – is there a risk of infection in cuts etc.? Football attracts the mass media, so a massive information campaign would be needed to prevent scandal stories at a later date. If directives came from above and a good level of co-operation was established, most interviewees would be willing to test the system. Small-scale testing would be an accessible route. There is a pedagogic potential in using urine in parks and at the same time informing the public, provided negative effects can be eliminated. One park was discussing using urine in its compost instead of artificial urea.

The food industry, the Union of Swedish Farmers (LRF) and consumer organisations

Most of the large food and feed companies policies encourage recycling of plant nutrients from town to country. However, during questioning it became clear that the feed industry and the mills will not permit fertilisation with human urine until more tests are carried out on pharmaceutical residues and until there is quality assurance of the product. There is a fear of negative press coverage being associated with brand names. The general opinion was that the Government should devote more funding to this issue, as it is a social problem. The meat industry currently permits the use of human urine, as does the leading dairy in the area under certain circumstances. The target of the LRF is for the majority of all nutrients to be recycled from town to country within a generation. They permit both urine and blackwater but not sewage sludge. Leading food companies, national organisations for the environment and sewage and urban councils are working together within the ReVAQ project, which allows monitoring of e.g. heavy metals, organic poisons and salmonella in recycling. Consumer organisations are generally positive to source separated toilet waste as opposed to sludge.

Urban authorities and housing companies

In many areas there is a lack of procedures to ensure that urine separation systems are correctly installed in buildings and then maintained. This has led to nutrient losses in the form of ammonia, and to rain and soil water leaking in. It is the responsibility of the urban council to supervise when granting permits for such systems and to collect the urine. Today, there is in practice inadequate or non-existent supervision of such systems.

Recycling companies for organic waste

One company that had the business concept of recycling urine for urban councils claimed that the amounts recycled were far too small to create a financial incentive for recycling. A lot of money has been invested in conventional systems, which have been developed over 50 years. If urine separation is allowed an equally long period of development, it will probably function and be financially viable. Initial funding was often readily available, as politicians wanted to improve their environmental profile, but there was a perception that difficulties arose in transferring recycling to general practice while trying to cut costs. It is not good for society to go in and pay all the recycling costs because of the high degree of unreliability in the initial phase. It is often

hard to withdraw this support at a later stage. It would be better to find a buyer who valued the nutrients. A computer system has been developed that allows traceability of every batch from the production source, to the storage sites, to the field on which it is applied and the time of application, to the crop grown etc.

Conclusions

There are users who are very positive to the use of human urine but one condition for this is that the quality of the urine as regards concentrations of plant nutrients and its freedom from harmful substances must be assured.

A well-functioning quality assurance system must be coordinated across the entire chain. Urban authorities bear the main responsibility for such coordination. The work in ReVAQ could perhaps act as an example.

The health and environmental risks of pharmaceutical residues have not been investigated. An analysis of the health and environmental risks of pharmaceutical residues in relation to recycling of human urine needs to be carried out.

The benefits of nutrient recirculation mainly belong to society as a whole and society should therefore support the development of these systems to the extent necessary. E.g. agreements regarding compensation for any losses suffered by individual farmers could be introduced.

Farmers and their customers within the food and feed industries are not very knowledgeable about human urine as a product and many believe the risks are as great as for sewage sludge. Since the general public has little information about the issues involved, press stories can have a great impact. We must provide extensive and accurate information to the market and change opinions. A public debate about the importance of recycling nutrients would be ideal. It might then transpire that the public will want us to await the results of testing for pharmaceutical residues, despite many believing that both the health and environmental risks in this regard are greater with the conventional waste systems of today.

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